EXECUTIVE SUMMARY

This Phase III Accreditation Support Package (ASP-III) is intended to provide the model user with high confidence statements of credibility that are supported by detailed verification and validation (V&V) assessments. The format of the information in this package is tailored to clearly identify those areas where the model can be used to support analysis, testing, and acquisition decisions.

ASP-III documentation includes an assessment of the accuracy of code implementation as well as comparisons with test data that show how well the model reflects behavior of real phenomena and/or systems being simulated. Information is presented in four sections; an introduction that describes content and purpose of the package, a verification report of findings for each functional element (FE) examined, and two validation report sections that address FE and model level results. Findings reported here are from independent V&V agents (IVAs) who have examined the software and conducted testing to verify proper implementation or have used data from testing to drive the model and compare predicted versus measured outputs.

Results of verification include identification of discrepancies in algorithms and embedded data with cited references as well as potential problems associated with overflow, underflow, improper logic and potential for exceeding array boundaries. Validation results for some FEs are characterized by means and standard deviations relative to values used by the model, while those for model level critical analytical issues (CAIs) usually involve statistical techniques that characterize distributions of predicted and measured populations. Even though some significant problems have been identified and several model deficiency reports (MDRs) have been submitted due to the activities performed thus far, continued use of the model can still be recommended.

Findings of IVAs chartered with line-by-line examination of the software itself and evaluation of the degree to which the implementation satisfies the design requirements and elements provided in Section 2 of ASP-II are summarized in Table i-1. Further details and comments about code quality can be found in the individual FE sections.

TABLE i-1. *ESAMS* Verification Results.

Functional Element	Discrepancy	Impact on Model Use
Target Signature	Improper variable initialization Error in glint correlation coefficient Elevation cofactor included in length calculations	None Large targets at close range Minor increase in azimuth tracking errors
Multipath (Native)	Invocation causes simulation abort Error in FACET calculation	Execution failure when enabled by the user When antenna points to quadrants other than 1
Clutter Rejection - MTI	None	
Angle Tracking	Possible divide by zero in DEMOD2 Small sum channel errors produce large angle errors	None None unless signal level falls below 10^{-30}
Range Tracking	None	

TABLE i-1. *ESAMS* Verification Results. (Contd.)

Functional Element	Discrepancy	Impact on Model Use
Force & Moment Generation	Possible array overflows due to non-limiting FMACH & AOA indexes	None
	Possible discontinuity when switching from primary to secondary angles	None
Missile Movement	Potential overflows in four functions	None
	Errors in heading can result in high, positive pitch angles	Unknown
	Heading can be outside limits during first iteration	None

Assessments of comparisons between test and/or intelligence data and model FEs are shown in Table i-2. Specific details of test conditions, procedures, and results are not included in this ASP version due to their system-specific nature, which results in classification at the SECRET level. A copy of individual report sections can be made available to eligible recipients by the SMART Project Office. FE validation has resulted in favorable comparisons with intelligence data upon which the model was based as well as with recent measurements from short range RF systems, but these have been limited to only one type of radar and missile combination. Comparisons of missile flyout FE performance with test data produced some surprising results while also raising more than a few questions, but certainly illustrated the need to examine larger populations of test samples before drawing conclusions.

TABLE i-2. *ESAMS* FE Validation Results.

Functional Element	Assessment	Impact on Model Use
On-Board Deceptive ECM	Angle track response to certain ECM waveforms was negligible	Receiver imbalance not captured in model
Angle Tracking	ATL response very close to S&TI data for system examined	Unknown until investigated for all systems modeled
Range Tracking	RTL response very close to S&TI data for system examined	Unknown until investigated for all systems modeled
Power Plant Boost	Thrust profile based upon exploitation data well below test data	Applicable to short range system only
Power Plant Cruise	Thrust profile based upon exploitation data slightly above test data	Applicable to short range system only
Autopilot	Predicted fin deflections compared very well with measured data	Applicable to short range system only
Missile Movement	Axial acceleration during boost and cruise phases compared fairly well with measured data, but drag values used in the model may be too high	Applicable to short range system only
	Lateral acceleration during boost and cruise phases compared well with measured data, but noisy model response attributed to input test data	Applicable to short range system only

TABLE i-2. *ESAMS* FE Validation Results. (Contd.)

Functional Element	Assessment	Impact on Model Use
Missile Movement (Contd.)	Missile speed profile compared well when thrust profile was adjusted to match test data	Applicable to short range system only
	Comparison of altitude trajectory was poor and probably due to insufficient pitching moment in model	Applicable to short range system only
	Ground track of trajectory was also poor, but may have been due to rotation of data during reduction	Applicable to short range system only

Validation efforts aimed at model level CAIs are summarized in Table i-3 but are also not included in the ASP due to potential classification problems. When a larger body of data becomes available, descriptions of findings applicable to families of systems rather than specific systems can perhaps be provided in this format. As with some of the FE comparisons, model level analyses always raised questions as to quality (accuracy or resolution) of the test data as well as the significance of the findings. No justification for discontinued model use was reported or recommended.

TABLE i-3. *ESAMS* Model Level Validation Results.

Model CAI	Assessment	Impact on Model Use
Target Tracking Non-maneuvering	Angle tracking errors in azimuth compared fairly well with test data, but were not as large as measured	None. Data may have been corrupted with noise during recording
	Angle tracking errors in elevation compared well with test data, but measured errors were much smaller than for azimuth.	None
	Range tracking errors compared well with test data after biases were removed and noise was filtered out	None
Target Tracking Maneuvering	Model could not maintain track on weaving target tracked by system.	Unknown until investigated further

Table i-4 identifies the individual Verification Report sections (VER) and FE Validation Report sections (VAL) that were addressed in preparation of the *ESAMS* ASP-III. Only VER sections are presented in this unclassified version. VAL sections will be included if they can be declassified or published in a separate classified addendum when the ASP is updated for the next model version.

Table i-4. Functional Element Cross Reference Matrix.

FUNCTIONAL AREA	#	FUNCTIONAL ELEMENT	2.0 VER	3.0 VAL
1.0 Target Characteristics				
	1	1.1 Flight Path		
	2	1.2.1.1 Signature RCS Static		
	3	1.2.1.2 Signature RCS Dynamic		
	4	1.2.2 Signature Fluctuations	2.4	3.4

Table i-4. Functional Element Cross Reference Matrix.

FUNCTIONAL AREA	#	FUNCTIONAL ELEMENT	2.0 VER	3.0 VAL
1.0 Target Characteristics	**5**	1.3.1.1 ECM Noise On-Board	2.5	
	6	1.3.1.2 ECM Noise Off-Board		
	7	1.3.1.3 ECM Noise Standoff		
	8	1.3.2.1 ECM Deception On-Board	2.8	3.8
	9	1.3.2.2 ECM Deception Off-Board		3.9
	10	1.3.2.3 ECM Deception Standoff		
2.0 Propagation				
	11	2.1 Masking		
	12	2.2 Clutter	2.12	
	13	2.3 Multipath/Diffraction	2.13	
	14	2.4 Atmospheric Attentuation		
3.0 Transmitter				
	15	3.1 Waveform Generator		
4.0 Receiver				
	16	4.1 Thermal Noise		
	17	4.2 AGC		
	18	4.3 Detector		
	19	4.4 Blanking		
5.0 Antenna				
	20	5.1 Gain		3.20
	21	5.2 Scan		
6.0 Signal Processing				
	22	6.1.1 Clutter Rejection MTI	2.22	3.22
	23	6.1.2 Clutter Rejection Doppler Filters		3.23
	24	6.2 Integration		
	25	6.3 Threshold		
	26	6.4 Pulse Compression		
7.0 Target Tracking				
	27	7.1 Angle	2.27	3.27
	28	7.2 Range	2.28	3.28
	29	7.3 Doppler		
8.0 Computer				
	30	8.1 Launch		
	31	8.2.1 Guidance Proportional Navigation		
	32	8.2.2 Guidance Command	2.32	
9.0 Power Plant				
	33	9.1 Boost		3.33
	34	9.2.1 Cruise Rocket		3.34
	35	9.2.2 Cruise Ramjet		
10.0 Flight Control				
	36	10.1 Uplink Receiver		
	37	10.2 Beacon Transmitter		
	38	10.3.1 Autopilot Lateral	2.38	3.38
	39	10.3.2 Autopilot Roll	2.39	3.39
11.0 Aerodynamics				
	40	11.1 Force and Moment Generation	2.40	3.40
	41	11.2 Missile Movement	2.41	3.41